

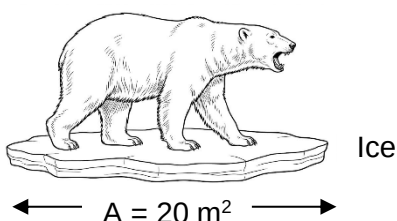
PAPER I [40 MARKS]

ANSWER ALL QUESTIONS

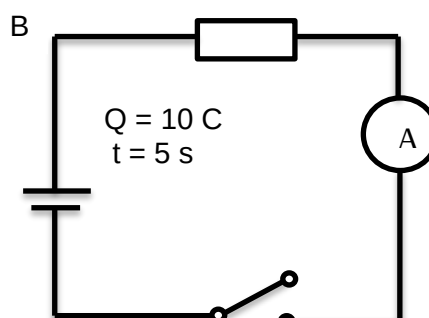
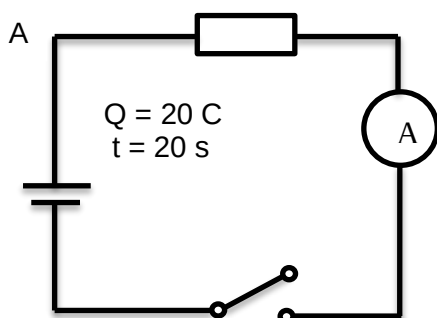
For each question, there are FOUR responses: **A**, **B**, **C** and **D**. Choose the corresponding letter of your response and **CIRCLE** it. If you change your answer, cross out the previous response clearly and circle your new answer. NO score will be awarded if you circle more than ONE letter.

1. A student wants to determine the thickness of a single sheet of paper. Which description correctly explains how to find it?

A measure one sheet directly using a ruler
B divide the total thickness by the number of sheets
C divide the number of sheets by the total thickness
D multiply the total thickness by the number of sheets
2. A rectangular ice slab with a surface area of 20 m^2 is floating on water, with the majority of its volume submerged. A polar bear stands on the slab, exerting a force as illustrated in the figure. Given that the average mass of the polar bear is 500 kg , calculate the pressure exerted on the ice slab. (Take $g=10 \text{ m/s}^2$).

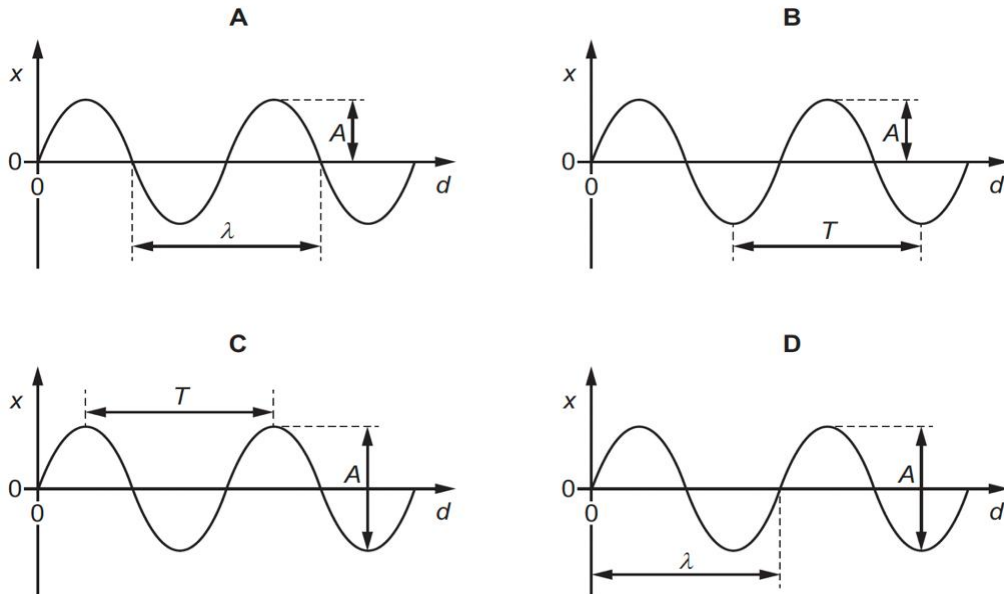


- A 250 Pa
B 400 Pa
C 1000 Pa
D 5000 Pa
3. Two simple circuits, A and B, have different amounts of charge passing through them over different time intervals, as shown in the figure. Which statement is correct regarding the currents I_A and I_B in these circuits?



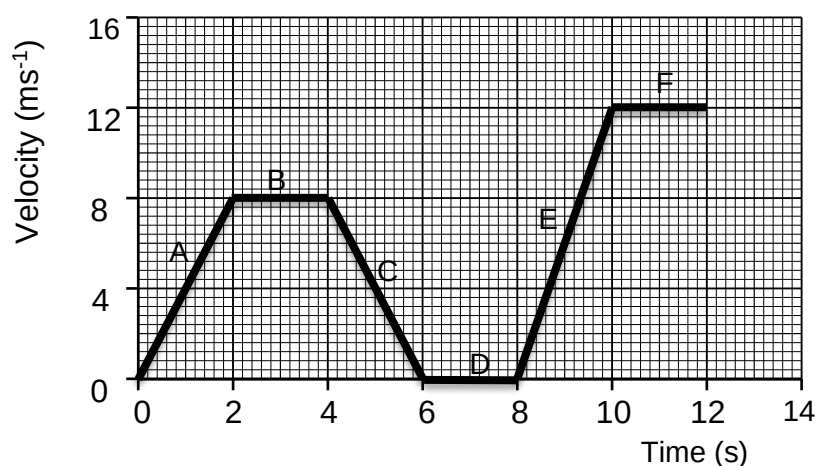
- A $I_A > I_B$
B $I_A < I_B$
C $I_A = I_B$
D $I_A \propto I_B$

4. A ray of light travels from glass into air. The angle of incidence in the glass is 30° , and the angle of refraction in air is 90° . What is the refractive index of the glass?
- A 4
B 3
C 2
D 1
5. A wave has period T , wavelength λ and amplitude A . The wave is shown on the graph of displacement x against distance d . Which graph is correctly labelled?



6. Which statement correctly compares the plum pudding model with the solar system model?
- A Electrons orbit the nucleus in the plum pudding model but are embedded in positive charge in the solar system model
B The plum pudding model has a nucleus, but the solar system model does not
C Most of the atom is empty space in the plum pudding model but not in the solar system model
D Positive charge is spread throughout the atom in the plum pudding model but concentrated in the nucleus in the solar system model
7. The reason why the maria are considered younger than the highlands is because
- A they exhibit a higher number of craters compared to the highlands
B the highlands are characterised by their taller and brighter features, indicating their formation before the maria
C they were formed through lava flows that occurred after the initial formation of the highlands
D they are formed by relatively more recent volcanic activity on the Earth's surface

8. A student observes pollen grains in water moving in a continuous random zigzag pattern. Two explanations are proposed:
Explanation 1: The motion is caused by collisions with constantly moving water molecules.
Explanation 2: The motion occurs because the pollen grains are able to move on their own.
 Which evaluation is most appropriate?
- A Explanation 1 is valid as it is supported by the kinetic particle model
 B Explanation 2 is valid as particles can move independently
 C Explanation 2 is valid because the particles are visible
 D Explanation 1 is invalid because water is at rest
9. A building is fitted with thermal insulation materials. After one year, the energy required for heating and cooling decreases significantly. Which evaluation best explains the environmental benefit of this improvement?
- A It allows heat to flow in only one direction
 B It traps heat and increases indoor temperature
 C It stops all heat transfer, eliminating energy use
 D It reduces heat loss, lowering energy use and emissions
10. A government evaluates four energy sources using renewability, reliability, scalability, and environmental impact. Which conclusion is most scientifically justified?
- A The best energy source must always be renewable because renewable sources have no disadvantages
 B Fossil fuels should always be preferred because they provide reliable energy
 C No single energy source is ideal; energy choices involve balancing reliability, environmental effects, and resource availability
 D Nuclear energy should replace all other sources because it produces no waste
11. The figure below shows speed–time graph. Identify the section in which the body is at rest.



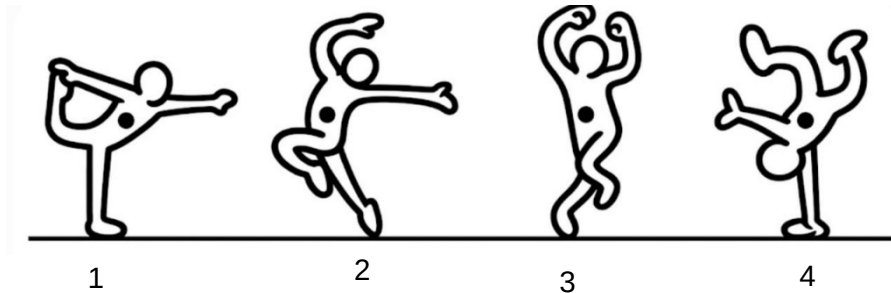
- A Section B only
 B Section D only
 C Section B and D

D Section B and F

12. What happens to the temperature of a substance during melting?

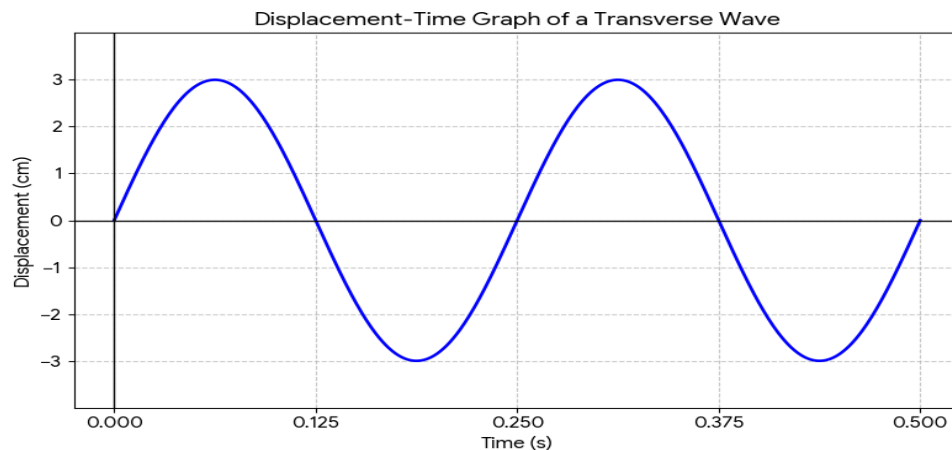
- A It remains constant
- B It increases continuously
- C It decreases continuously
- D It first increases, then decreases

13. The figure below shows different dancing positions of a person, each with their center of gravity (CG) marked with a black dot on their body. Which position of the dancer is most stable?



- A 1
- B 2
- C 3
- D 4

14. A student observes the displacement–time graph of a transverse wave as shown in figure below. If the maximum displacement from the equilibrium position is 3 cm and one complete cycle occurs in 0.25 seconds, what are the amplitude and frequency of the wave?

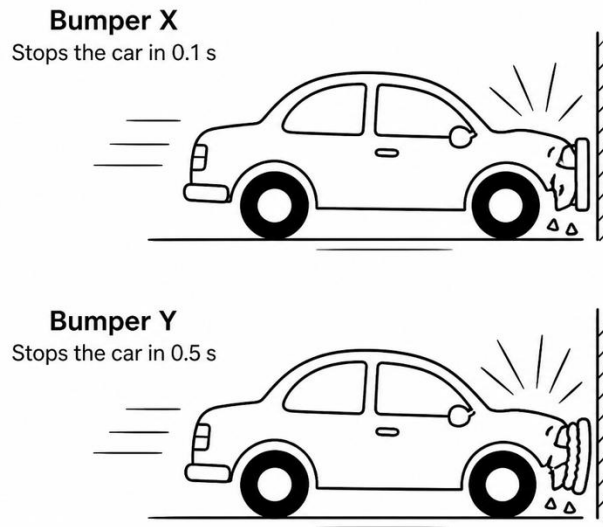


- A Amplitude: 3 cm, Frequency: 4.0 Hz
- B Amplitude: 6 cm, Frequency: 4.0 Hz
- C Amplitude: 3 cm, Frequency: 0.25 Hz
- D Amplitude: 1.5 cm, Frequency: 2.0 Hz

15. In modern communication systems, digital signals are preferred over analogue signals because of their advantages. Which statement correctly describes a benefit of digital signals?
- A It needs continuous amplitude changes
 - B It can maintain signal quality
 - C It is easily affected by noise
 - D It cannot be stored digitally
16. A ray of light travels from glass into air. The angle of incidence is increased gradually until no refracted ray is observed and the light is completely reflected back into the glass.
- Which condition describes total internal reflection (TIR)?
- A Rarer $\rightarrow$ denser; $i > c$
 - B Denser $\rightarrow$ rarer; $i < c$
 - C Denser $\rightarrow$ rarer; $i > c$
 - D Denser $\rightarrow$ rarer; $i = c$
17. During an experiment, a loudspeaker produces sound. The teacher explains that the sound travels through the air by creating regions where air particles are close together and regions where they are farther apart. What are these regions called?
- A Compressions and rarefactions
 - B Nodes and antinodes
 - C Peaks and valleys
 - D Crests and troughs
18. A mechanic uses a hydraulic jack to lift a vehicle. The cross-sectional area of the input piston is 0.01 m^2 and that of the output piston is 0.05 m^2 . If the mechanic applies a force of 200 N on the input piston, what force is exerted by the output piston on the vehicle?
- A 40 N
 - B 200 N
 - C 1000 N
 - D 5000 N
19. What happens to the ultrasound waves when they encounter a boundary between two different types of tissue?
- A Some waves are reflected back
 - B They are converted into radiation
 - C They are completely absorbed and disappear
 - D They bounce off the skin and never enter the body
20. When a car moves forward and then stops suddenly, the object placed on the car is thrown forward. Which principle best explains why the object moves forward when the car stops
- A Newton's second law of motion
 - B Law of conservation of energy
 - C Universal law of gravitation
 - D Newton's first law of motion

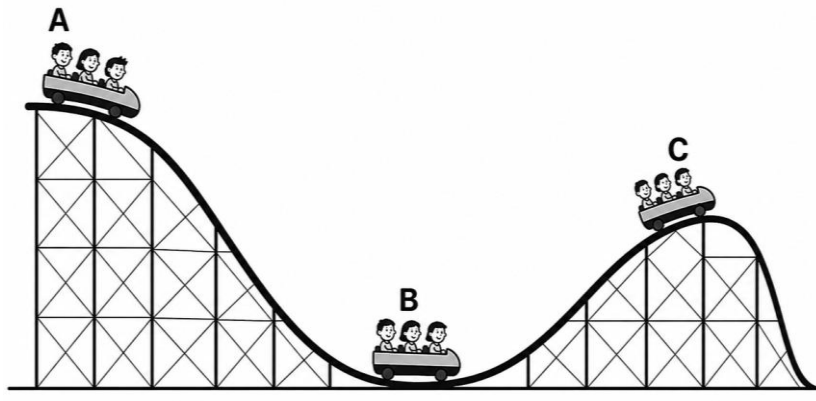
21. Which combination of resistors gives the smallest equivalent resistance?
- A Series
 - B Parallel
 - C Mixed
 - D Single resistor only
22. A device uses 100 W of power for 10 seconds. How much energy is used?
- A 10 J
 - B 100 J
 - C 1000 J
 - D 10000 J
23. In a generator, maximum induced e.m.f. occurs when the coil is
- A stationary in the field.
 - B fully outside the field.
 - C moving parallel to magnetic field lines.
 - D cutting magnetic field lines at right angles.
24. A local construction company reports that the density of a specific grade of sand is 1.6 g/cm^3 . If a project requires the density to be recorded in SI units for an international safety audit, which of the following is the correct value?
- A 160 kg/m^3
 - B 0.016 kg/m^3
 - C $1,600 \text{ kg/m}^3$
 - D $16,000 \text{ kg/m}^3$
25. Two teams pull a heavy crate. Team A pulls with a force of 300 N due North, while Team B pulls with a force of 400 N due East. What is the magnitude of the resultant force acting on the crate?
- A 500 N
 - B 400 N
 - C 300 N
 - D 100 N

26. A safety engineer is testing two different car bumpers. Bumper X stops a car in 0.1 seconds, while Bumper Y stops the same car (at the same speed) in 0.5 seconds as shown in the figure below. Which of the following statements correctly evaluates the physics of the impact?



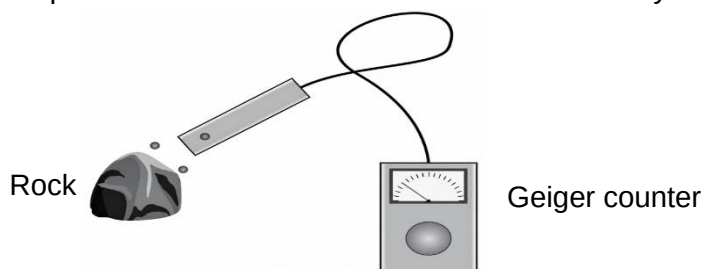
- A Bumper X is safer because it produces a larger impulse
- B Bumper X is safer because it reduces the total change in momentum more quickly
- C Both bumpers provide the same force because the change in momentum is the same
- D Bumper Y is safer because it increases the time of impact, thereby reducing the average force
27. A 500 kg crate is pushed across a factory floor. The friction between the crate and the floor generates 2,500 J of thermal energy over a distance of 10 meters. What is the magnitude of the frictional force opposing the motion?
- A 25N
- B 250N
- C 2,500N
- D 25,000 N

28. In a simulation of a roller coaster, a car starts from rest at Point A (height h). It rolls down to Point B (ground level) and then climbs to Point C (height $h/2$) as shown in the figure below. If friction is neglected, which statement accurately describes the energy transformation?



- A At Point B, the car has maximum potential energy
 B The work done by gravity is zero because energy is conserved
 C At Point C, the car's kinetic energy is less than its kinetic energy at Point B
 D Total mechanical energy at Point A is greater than at Point C and at point B
29. Using the James Webb Space Telescope (JWST), astronomers discovered a distant red galaxy, EGS-z11-R0, with a measured redshift of 11.45. The light from this galaxy is significantly shifted towards longer wavelengths compared to laboratory measurements. What is the most appropriate interpretation of this observation?
- A The galaxy is moving rapidly towards the Earth
 B The galaxy is moving away from the Earth at high speed
 C The galaxy is absorbing blue light from nearby stars
 D The galaxy is stationary but appears red due to temperature
30. A radioactive isotope of uranium, ${}_{92}^{238}\text{U}$, undergoes decay. It first emits an α -particle, and the resulting nucleus then emits a β -particle. Which set of equations correctly represents these two decays?
- A ${}_{238}^{92}\text{U} \rightarrow {}_{238}^{92}\text{Th} + {}_2^4\text{He} \rightarrow {}_{234}^{92}\text{Th} \rightarrow {}_{234}^{91}\text{Pa} + {}_{-1}^{10}\text{e}$
 B ${}_{238}^{92}\text{U} \rightarrow {}_{234}^{90}\text{Pa} + {}_2^4\text{He} \rightarrow {}_{234}^{92}\text{Th} \rightarrow {}_{234}^{90}\text{Pa} + {}_{-1}^{10}\text{e}$
 C ${}_{238}^{92}\text{U} \rightarrow {}_{236}^{90}\text{Th} + {}_2^4\text{He} \rightarrow {}_{236}^{92}\text{Th} \rightarrow {}_{236}^{91}\text{Pa} + {}_{+1}^{10}\text{e}$
 D ${}_{238}^{92}\text{U} \rightarrow {}_{234}^{90}\text{Th} + {}_2^4\text{He} \rightarrow {}_{234}^{92}\text{Th} \rightarrow {}_{233}^{91}\text{Th} + {}_{-1}^{10}\text{e}$
31. A skydiver falls before opening a parachute. When the parachute opens, the drag force increases greatly. Which factor best explains this change?
- A streamlined shape increases airflow speed
 B higher air density and increased turbulence
 C drag decreases due to energy conversion into heat
 D larger surface area creates a blunt shape, increasing drag

32. Scientists test a rock with a Geiger counter and find that it is emitting radiation (see figure). They suspect the radiation is α -radiation. How could they confirm this?



- A Move the detector further away from the rock
 B Heat the rock and observe changes in radiation
 C Place a sheet of paper between the rock and the detector
 D Place a thick lead block between the rock and the detector
33. A beam of white light passes through a glass prism during a classroom experiment. Students observe that the light spreads out into a range of colours on a screen. What is the reason for the formation of different colours?
- A The prism absorbs some colours and reflects others
 B White light contains only one wavelength that splits in the prism
 C All colours travel at the same speed, but change direction randomly
 D Different colours travel at different speeds in glass, causing separation
34. The sound produced by a musical instrument travel through air with a frequency of 500 Hz, and the speed of sound in air is 340 m/s. What is the wavelength of the sound wave?
- A 0.34 m
 B 0.68 m
 C 1.47 m
 D 170 m
35. Four electrical components X, Y, Z, and W have the following current–voltage (I–V) characteristics:

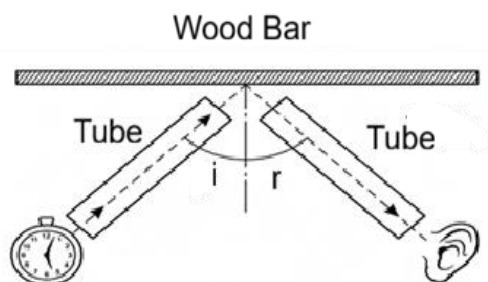
Electrical components	Characteristics of I-V graph
X	Straight line passing through the origin.
Y	Graph becomes less steep as voltage increases.
Z	Conducts current in one direction after the threshold voltage
W	Resistance decreases as temperature increases.

Which row correctly identifies the four components?

- A X = Ohmic resistor; Y = Thermistor; Z = Diode; W = Filament lamp
 B X = Ohmic resistor; Y = Filament lamp; Z = Diode; W = Thermistor
 C X = Diode; Y = Filament lamp; Z = Ohmic resistor W = Thermistor
 D X = Filament lamp; Y = Ohmic resistor; Z = Thermistor; W = Diode

36. During a food science experiment, students use a calorimeter to determine the energy content of a sample of food. The food is burned, and the heat released raises the temperature of a known mass of water. Why is calorimetry suitable for this application?
- A It measures the mass of food lost during burning
 - B It measures electrical energy directly from the food
 - C It increases the temperature of the food to measure its energy
 - D It determines heat energy released by measuring temperature change
37. A hydropower technician measures the pressure difference between two points in a water column inside a dam. The vertical height difference between the two points is 12 m. The density of water is 1000 kgm^{-3} , and $g=10 \text{ ms}^{-2}$. What is the pressure difference between the two points?
- A $1.2 \times 10^5 \text{ Pa}$
 - B $1.2 \times 10^4 \text{ Pa}$
 - C $1.2 \times 10^6 \text{ Pa}$
 - D $1.2 \times 10^3 \text{ Pa}$
38. During a classroom demonstration, three objects are placed in different positions:
- Object P is placed at the bottom of a bowl.
 - Object Q is placed on a flat horizontal surface.
 - Object R is balanced at the top of a dome.
- When slightly displaced, each object behaves differently. Which statement correctly describes their types of equilibrium?
- A P: unstable, Q: stable, R: neutral
 - B P: stable, Q: neutral, R: unstable
 - C P: neutral, Q: stable, R: unstable
 - D P: stable, Q: unstable, R: neutral
39. Why is solar mass important?
- A It indicates the brightness of distant stars
 - B It shows that all stars have the same mass
 - C It makes comparison of star masses easier
 - D It measures the temperature of different stars

40. In an experiment on reflection of sound, a student measures the angles of incidence and reflection using a sound source and tubes as shown in the figure. Which observation confirms the law of reflection?



- A Angle of incidence is less than angle of reflection
- B Angle of incidence is greater than angle of reflection
- C Angle of incidence is equal to the angle of reflection
- D Angle between incident and reflected waves is perpendicular